2003-05-01

Water Conservation Technologies

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Recommended Citation

McCarton, L., O'Hogain, S.: Water Conservation Technologies, Volume 58, Issue 03, Pages 50-51, May 2003, The Engineers Journal, Ireland.

WATER WATER EVERYWHERE

Given the increasing incidence of serious flooding in Europe in recent years it might seem odd to be addressing the problem of water conservation. However, recent economic prosperity has led to an increased per capita use of water for domestic and industrial use. Liam McCarton, Department of Civil and Structural Engineering, DIT Bolton St addresses the issue of water conservation in a two part special report.

The traditional approach to meeting increased demand is to augment supply. However, mobilising new resources involves ever higher costs. Allied to this is the concept of sustainability, which can be defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

An important consideration of itself, sustainability forms a major part of the new EU water strategy outlined in the Water Framework Directive 2000, which member states have three years to transpose into national legislation. Therefore, the concept of water conservation and water saving technologies are set to play a major role in our lives.

Increasing the rate of water efficiency requires a multi-dimensional approach that can be achieved by adopting alternative technologies. The application of these technologies is further facilitated by the growth in urbanisation and the scale of change in demand patterns.

SUSTAINABILITY

A quarter of all European water consumption is in urban areas (households, public buildings and commercial establishments). The urban population has traditionally received its water via a mains network and disposed of wastewater via a piped sewerage system.

A number of problems have been linked to centralised supply and disposal systems. These include resources not located in areas of high demand and increased surface water runoff volumes due to urbanisation. An alternative and more long term sustainable option is to manage water demand in parallel with the development of sustainable water supplies to meet increased total water demand.

Water efficiency can be increased by reducing the amount of water required for every day use. Fixture and appliance retrofitting, aligned with providing an alternative water supply (rainwater) and reducing water demand through using greywater (used water that does not contain faecal material) can contribute significantly to the sustainability of water resources.

WATER DEMAND

The demand for water in Ireland is increasing, not only in relation to population growth, but also with regard to changing socio-economic patterns. Rising lifestyle standards are reflected in an increased level of ownership of appliances, a shift in household size to one-person households and expanded municipal supply networks. The demand of an increasing industrial sector must also be taken into account. Agricultural use of water is another important water use, which has not been well catalogued and researched. Table 1 presents data on water consumption in Ireland in 1996.

	TOTAL (M3/DAY)	SURFACE WATER (M3/DAY)	GROUNDWATER (M3/DAY)
PUBLIC WATER SUPPLIES	1,381,000	1,184,000	197,000
RURAL DOMESTIC	32,000	-	32,000
INDUSTRY (PRIVATE SUPPLIES)	179,000	79,000	100,000
AGRICULTURE (PRIVATE SUPPLIES)	249,000	-	-
THERMAL POWER (FRESH WATER)	774,000	774,000	-
TOTAL WATER USAGE	2,615,000	2,037,000	329,000

Table 1. *Water Consumption in Ireland 1996 (McCarthaigh, 1996).*

The pace of economic development will increase the demand on water supply infrastructure over the next 10 years. The average per capita water consumption (PCC) for Ireland in 1997 varied between 130 l/h/d to 139 l/h/d (WS Atkins, 2000). Projections for the year 2018 indicate a PCC of between 146 and 158 l/h/d. Figure 1 illustrates the main uses of water in a domestic situation, where toilet flushing, showering/bathing and clothes washing account for almost 80 per cent (IPTS, 1999).

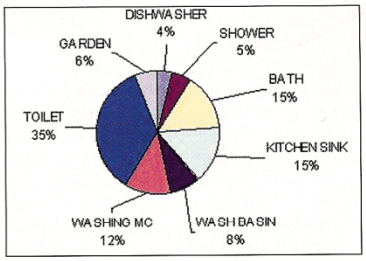

Fig 1. Typical breakdown of household water use

ECONOMICS

Economics is an important issue in sustainability. Water services in Ireland are mainly delivered by local authorities to both domestic and non-domestic sectors. Current government policy requires that local authorities should apply charges to the non-domestic sector that reflect the costs (both capital and operational) of provision of water and wastewater services. These charges are to be applied on the basis of a unit charge in respect of metered water supply.

Local authorities are required to achieve universal metering of water supplied to the non-domestic sector by 2006. This is in accordance with the Water Framework Directive 2000, which states that 'Member states shall ensure that by 2010 water pricing policies provide adequate incentives for users to use water resources more efficiently and an adequate contribution of the different users to the recovery of the cost of water services'

It is likely that once the true cost of provision of water to the consumer is applied that the water conservation/efficiency features of consumer goods will be a priority selling point. This will raise public awareness of water related environmental issues and encourage users to value water as an important resource.

These developments will result in technologies that increase water efficiency and reduce mains water usage becoming economically attractive to both domestic and non-domestic users. Increasing water use efficiency will contribute to the sustainability of water supply and also reduce economic costs to the supplier and end user.

WATER EFFICIENCY AND REUSE TECHNOLOGIES

Figure 2 illustrates the three main strategy options to balance demand and supply in a building. The amount of water required to carry out a given task can be reduced through good housekeeping practices and the use of water efficient fittings/appliances. Alternative supplies such as rainwater can be utilised and greywater can be recycled for reuse in the building.

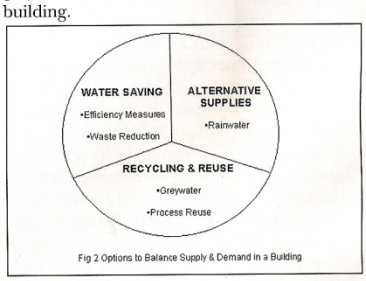

Fig 2 Options to Balance Supply & Demand in a Building

Options to balance supply and demand in a building

Water technology options range from small scale measures at the demand side, information technologies at network level, to large scale interventions at the source side, i.e. using recycled water and/or salted water. Table 2 presents a review of these domestic water technologies.

WATER END USERS			WATER SUPPLIERS		
			NETWORK		SOURCE
INDOOR WATER SAVING FIXTURES AND APPLIANCES	OUTDOOR WATER SAVING DEVICES	RAINWATER AND GREYWATER REUSE	DISTRIBUTION NETWORK LEAKAGE DETECTION AND OPTIMISATION TECHNOLOGY	PRESSURE MANAGEMENT TECHNOLOGY	WATER DESALINATION RECYCLING PLANTS, DUAL PIPING

Table 2. *Examples of domestic water technologies (Suzenet et al., 2002)*

Statistics from the water supply sector indicate that unaccounted for water levels are in the region of 47 per cent nationally due to a combination of leakage and insufficient management information and metering. This paper will not examine network inefficiencies but will focus on the technologies applying to the water end users. Technologies at the end-use address indoor and outdoor water usage. These can be grouped together as:

- Water Efficiency measures
- Rainwater Harvesting
- Greywater reuse

WATER EFFICIENCY MEASURES

It is possible to significantly reduce the water demand in a building without affecting the comfort of the occupants. Measures for water efficiency here include fixture and appliance retrofitting and installation of dual flush toilets and low flow showerheads (retro-fitting refers to adapting or replacing an existing fixture or appliance to increase water use efficiency). Studies in European countries have shown that replacing existing fixtures/appliances with low flush toilets, economy washing machines and flow limiting showerheads and faucets can result in an overall reduction in water demand of over 30 per cent.

Low-flow plumbing fixtures and retrofitting programmes are permanent, one time conservation measures that can be implemented with little or no additional cost over the lifetime of the fixtures. Savings can also be made if water is subject to supply charges. The pay back time to end-users is often less than two years for low flow fixtures. For the more expensive measures such as replacing toilets, payback times may be of the magnitude of ten years (Burrill,1997).

APPLIANCES/ FIXTURES	WATER USE	PER CENT REDUCTION.
TOILETS	LITRES/USE	
CONVENTIONAL	9	
LOW-FLOW	6	33
SHOWERHEADS	LITRES/MIN	
CONVENTIONAL	14	
LOW-FLOW	10	29
FAUCETS	LITRES/MIN	
CONVENTIONAL	12	
LOW-FLOW	10	17
FLOW-LIMITING	4	67
WASHING MACHINES	LITRES/USE	
CONVENTIONAL	80	
EFFICIENT	60	25
ECONOMY	40	50

Table 4. *Examples of potential savings in the EU (IPTS, 1999, Boymanns, 2001).*

Typically washing machines and toilets account for 47 per cent of domestic water consumption. Using low flow 2/4 litre toilets and water efficient appliances (50 litres/use washing machines) savings of up to 11,500 litres of water a year for each person are possible. This represents 24 per cent of daily household use.

Water savings from water efficiency measures have the potential to reduce current PCC rates by up to 31.5 l/hd/d. The Building Research Establishment (BRE) has carried out studies in the UK to quantify the water consumption reductions achievable in domestic dwellings by installing efficiency technologies. Houses were selected and water efficient appliances and fixtures were fitted. Water consumption from these houses indicated a PCC rate of 97 l/h/d. This compares with the average UK PCC of 149 l/hd/d (Legget et al., 2001).

TOILETS	LOW FLUSH TOILETS TYPICALLY USE 6 LITRES OF WATER PER FLUSH, AS AGAINST 7 AND 9 LITRES IN OLDER MODELS. SOME NEWER MODELS USE 2 LITRES FOR URINE AND 4 LITRES FOR SOLIDS. WATERLESS URINALS ARE A SUCCESSFUL ALTERNATIVE IN PUBLIC LOCATIONS. INSTALLING AUTOMATIC CONTROLS ON FLUSHING CISTERNS FOR URINALS CAN REDUCE THE WATER CONSUMED BY 78 PER CENT. INTERNAL OVERFLOWS.
SHOWERS, BATHS AND BASINS.	LOW FLOW SHOWER HEADS.
TAPS.	HANDS FREE TAP. SPRAY, LOW FLOW TAPS AND AERATORS. THESE CAN ACHIEVE A FLOW REDUCTION FROM 0.2 LITRES/SECOND TO 0.04 LITRES/SECOND RESULTING IN A SAVING OF 0.16 LITRES/SECOND OR 80 PER CENT.
WHITE GOODS.	ECO-LABELLING. NEWER WASHING MACHINES WILL SOON USE 20 LITRES PER WASH CYCLE COMPARED WITH THE NORMAL 80–100 LITRES
GARDENS	THERE ARE MANY UNCERTAINTIES IN THE SCALE OF OUTDOOR WATER USE, DUE TO LIMITED AVAILABLE INFORMATION. STUDIES IN GERMANY, FRANCE AND THE UK INDICATE THAT THE MAJOR OUTDOOR USE FOR WATER IS GARDENING. THE INCREASE IN OUTDOOR WATER DEMAND HAS SEEN A GROWTH IN RETAIL SALES OF WATERING PRODUCTS OF APPROXIMATELY 20 PER CENT PER ANNUM IN THE 1990S (IPTS, 1999).

Table 3. *Water Efficiency and Conservation Measures.*

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In the second part of this article Liam McCarton will address the alternative options of rainwater harvesting and grey water recycling.